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Technical Report No. 6

[redacted]

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a. Current Status of Work

The following areas have been worked on during the period starting July 24, 1965.

1. Some Remarks about the Precision of the Sine Wave Equipment.

During this period we tried to measure the precision with which the τ could be measured. For a while we encountered some real difficulties in getting the results to repeat for different targets. This was traced to birefrigence in the film strips used for the targets. It turns out that the film base is birefrigent. In fact, the film base is so bad in this respect that we are modifying our equipment to take glass plates. The new plate holder is being tested now.

The two beams in the target unit have to be balanced in intensity. It is shown in our proposal that when the target film is assumed to pass 100% of the light in the light strips and 0% of the light in the dark strips and the polarizers are perfect, the intensity in the target beam should be twice as large as the intensity in the flooding beam. In reality these conditions do not hold true. We will discuss here the influence of these two effects.

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Let us define the following quantities:

I = intensity of beam illuminating the target

I' = intensity of beam illuminating the flooding beam

T_b = transmission of the clear bars in the target

T_o = transmission of the dark bars in the target

α = the transmission of a set of crossed polarizers that is not perfect

θ = angle at which the polarizer which changes the visibility is set.

It is easily derived that the visibility of our target assembly is now given by

$$V = \frac{(T_b - T_o)\, I \left\{1-(1-\alpha)\sin^2\theta\right\}}{(T_b+T_o)I\left\{1-(1-\alpha)\sin^2\theta\right\} + 2I'\left\{1-(1-\alpha)\cos^2\theta\right\}} \qquad (1)$$

We should remember that we still can adjust the ratio $\frac{I'}{I}$.

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When we adjust this ratio to

$$\frac{I'}{I} = \frac{1}{2}(T_b + T_o) \qquad (2)$$

Equation (1) then becomes

$$V = \frac{T_b - T_o}{T_b + T_o} \quad \frac{1 - \alpha}{1 + \alpha}\left[\cos^2\theta + \frac{\alpha}{1 - \alpha}\right] \qquad (3)$$

We notice that

$$V_{target} = \frac{T_b - T_o}{T_b + T_o} \qquad (4)$$

with which we get for (3)

$$V = V_{target} \quad \frac{1 - \alpha}{1 + \alpha}\left[\cos^2\theta + \frac{\alpha}{1 - \alpha}\right] \qquad (5)$$

It is therefore extremely important that the best possible polaroids are used.

We will continue to try to further improve the precision with which these measurements can be made.

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2. Target Fabrication

In order to fabricate the 15-bar targets, we built three special cameras to get all three target groups on the film.

Camera No. 1 is shown in Fig. 1. This camera puts the first target group on the film (1 - 10 lines/mm). The film or the plate is held by a holder. The film-holder is shown in Fig. 4, together with the three ball arrangement on the cameras. This ensures that the film is securely located on each camera. The plate holder uses the same ball arrangement.

Camera No. 2 is shown in Fig. 2. The target group from 10 - 100 lines/mm is photographed with this equipment. In Fig. 3, both cameras No. 2 and No. 3 are shown. Camera No. 3 takes the target group from 100 - 1000 lines/mm. The special arrangements to locate the film with the three balls is extremely important here since the depth of focus of this camera is only a fraction of a micron. The focussing in cameras No. 2 and No. 3 is critical and the lenses can be focussed by a set of parallelogram springs. A close-up of this arrangement for camera No. 2 is shown in Fig. 6. The same arrangement is used in camera No. 3, but a differential spring arrangement is added here to make extremely small focussing adjustments possible.

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With camera No. 3 we made actual targets of 1000 lines/mm which were clearly resolved.

Fig. 5 shows the focussing arrangement and the target location arrangement of camera No. 3.

Fig. 7 gives actual samples of targets up to 100 lines/mm.

Fig. 8 shows the breadboard sine wave tester on which the preliminary precision measurements are made.

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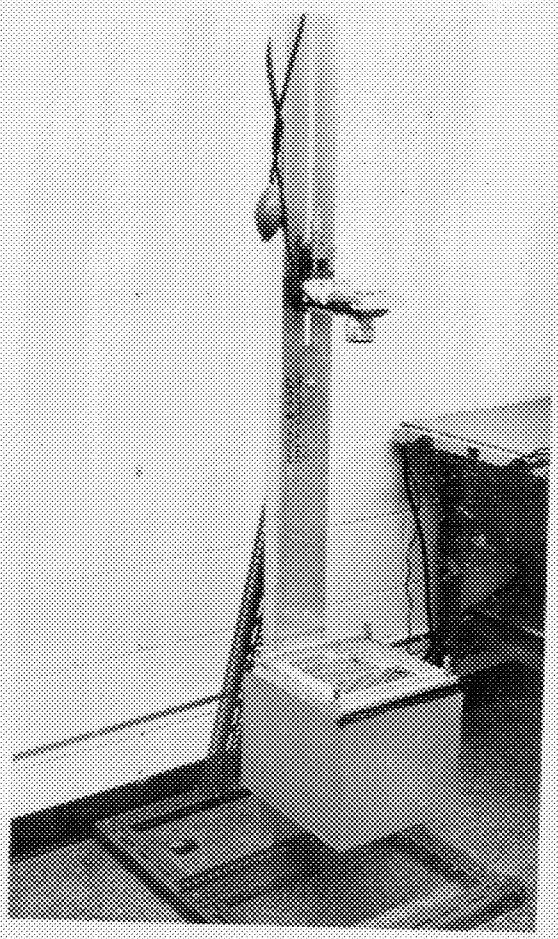

Fig. 1

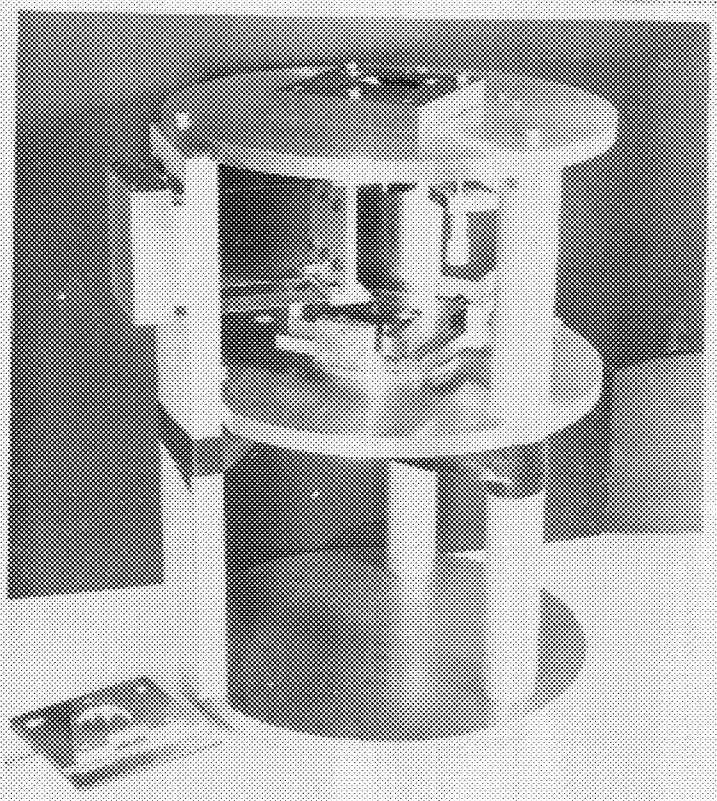

Fig. 2

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Fig. 3

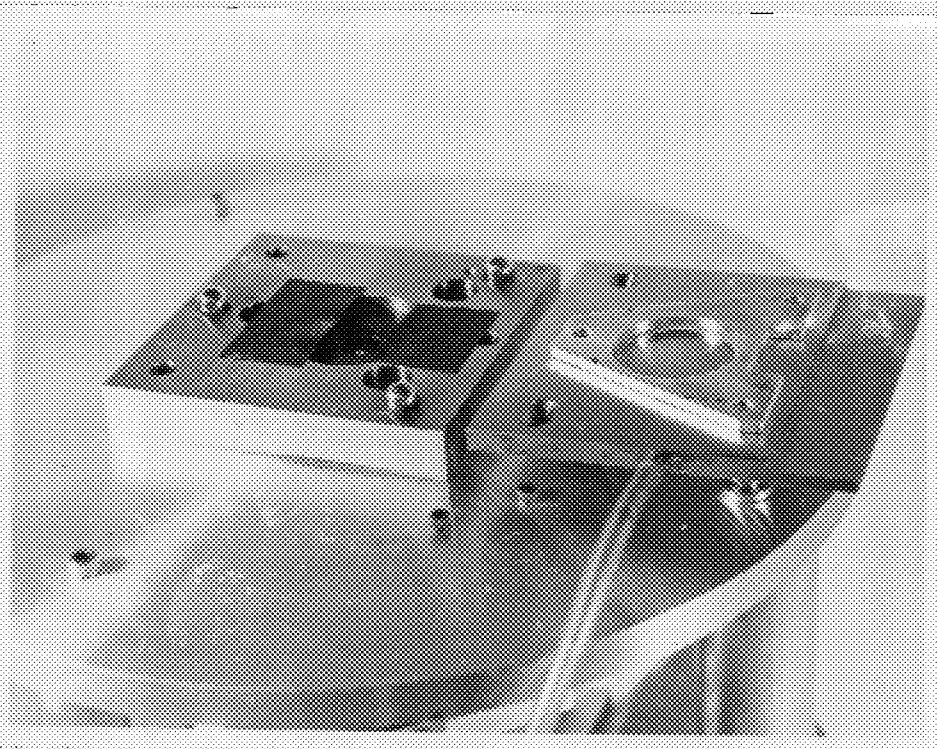

Fig. 4

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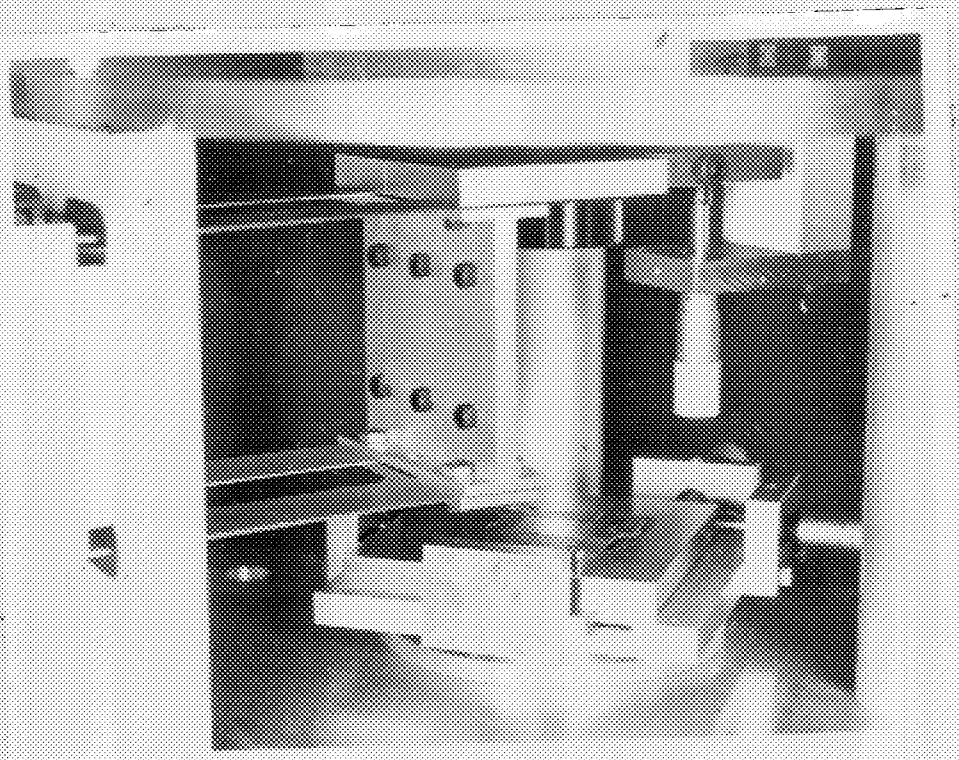

Fig. 5

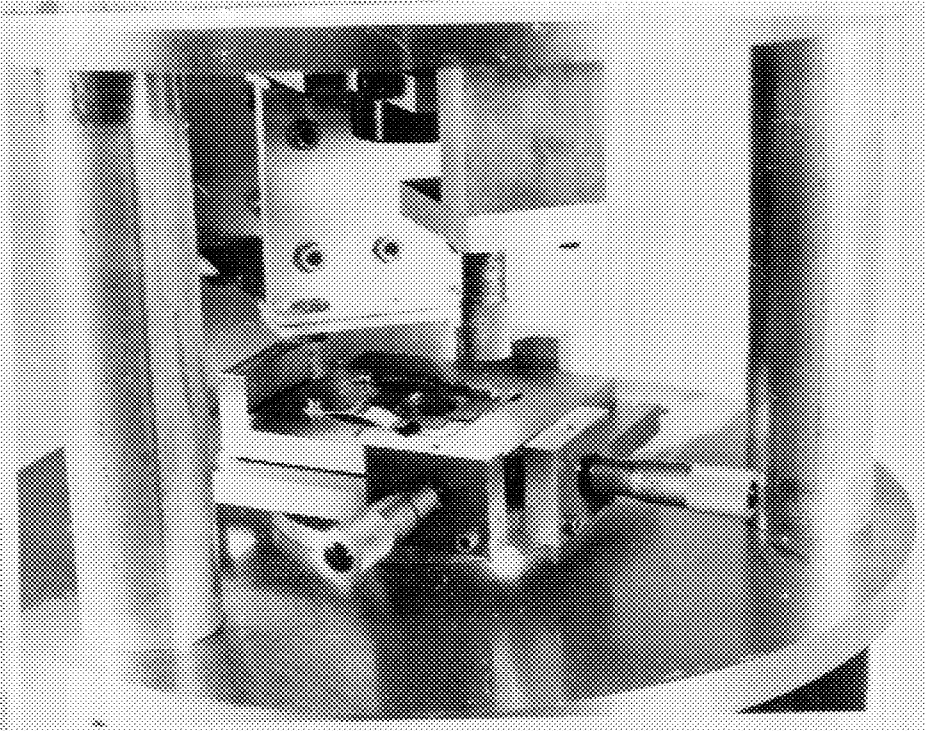

Fig. 6

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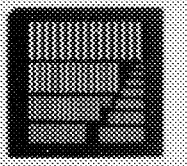

Fig. 2

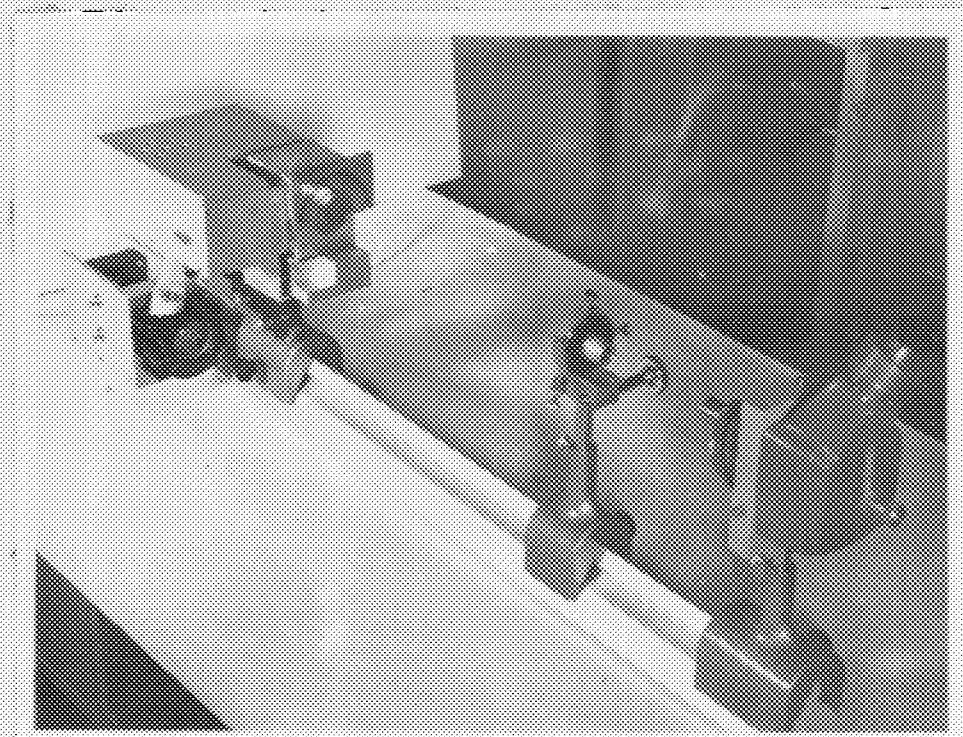

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Fig. 3

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